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~~DESCRIPTION~~

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## Background of the Invention

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station 2. This function must be aware how communication with the field device 1 can be carried out. Conversely, the field device 1 must also be aware how messages can be transmitted to the associated function.

In any description of this communication, a distinction is drawn between

- logic links, which describe transmitters; receivers and the nature of the message, and
- communications parameters, which describe how the transmission takes place.

Logic links are specified by unit identifications or network addresses. Communications parameters contain data types and data formats which are required when calling functions. Such information about a communications link is defined on an application layer in the generally known ISO communications layer model.

An individual message via a logic link between a field device 1 and an associated function conveys, for example, a position of a switch which is controlled by the field device 1, to an optical display within an installation diagram and/or to an event list and/or to an alarm function in the control station 2. A Standard for definition of communications links for station control engineering is described in a draft of an IEC Standard 61850. A summary of this can be found in the lecture documents relating to a VEW Energie AG Workshop of 1.21.99, by Jochen Haude.

During the configuration or engineering of an installation based on the prior art, device functions of the field device 1 and functions on a control station 2 are selected for integration of a field device 1, these functions are associated with one another, and logic links and communications parameters are specified. This is done by means of signal lists which specify in the form of text which functions of the control station 2 are associated with a specific

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The object of the invention is therefore to provide a method and a system for integration of a field device in an installation control system of the

### Summary of the Invention

type mentioned initially, which avoid the disadvantages mentioned above.

This object is achieved by a method and a system for integration of a field device in an installation control system having the features of patent claims 1, 10 and 12.

In the method according to the invention for integration of a field device in an installation control system which has a communications network and a control station,

- the field device transmits a description of its device functions to the control station in a standardized form,
- functions associated with the field device are installed on the control station and logic communications links are produced automatically between the device functions and the functions of the control station.

Device functions are thus represented as software components which can not only carry out their functions associated with installation operation but also provide information about the device function itself and about configuration of the device function within the installation control system, in standardized form.

Communications links between field devices and associated functions in the control station are thus produced automatically during physical installation and commissioning, without corresponding logic links and communications parameters needing to be specified in a preceding planning phase.

One advantage of the invention is thus that no detailed logic links and communications parameters need be specified by hand, thus saving a large amount of effort in engineering. A further advantage is that a significant proportion of the engineering does not take place until physical installation and commissioning and that there is therefore no need to develop and store a

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consistent, system-wide description of all the communications links in advance. A further advantage is that there is thus no need to exchange relatively large amounts of data between different engineering tools for configuration of field devices and the control station. Furthermore, no mechanisms are required to ensure consistency of such data, and the majority of errors resulting from inconsistent data are eliminated. This reduces the effort for commissioning and improves the quality of a resulting installation control system.

In a first preferred variant of the invention, the control station does not actually contain any information about a structure of the installation before physical installation. During the physical  
15 installation of a field device, a graphics equivalent or representation, for example, of the field device is produced in the control station. Using a number of such equivalents, an operator manually produces a representation of the structure of the installation on  
20 the control station.

In a second preferred variant of the invention, the control station contains information about a structure of the system, and a field device is manually associated by an operator with an element of the installation structure during the physical installation.

In a third preferred variant of the invention, the control station contains information about the structure of the installation, which also includes the identifications of the field devices. During the physical installation of a field device, it transmits an identification stored in the field device. Using this identification, the correct communications links are produced automatically, corresponding to the structure of the installation.

The device functions provided by the field device preferably allow access to all the data which are required for engineering and for configuration of

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the field device within the installation control system. The functions carried out on the control station and associated with a field device are preferably interface functions for operation of the field device and for displaying data relating to the field device.

In one preferred variant of the invention, specific standard functions and corresponding logic links are installed automatically in the control station without any corresponding specification needing to be present in the installation structure or by the operator. For example, alarm functions and/or device functions which produce events are automatically connected to corresponding control station functions which process alarms and events, respectively.

In one advantageous variant of the invention, generic functions which can be associated with a field device are contained in the control station even before the physical installation of a field device. In another advantageous variant, such functions are stored in the field device and are transmitted to the control station during the physical installation of the field device. In a further advantageous variant, such functions and/or unit-specific data, such as an identification, are not stored in the field device itself, and only an address, for example a URL (Uniform Resource Locator) at which this information can be called is associated with the field device.

In one preferred variant of the invention the invention is used in high-voltage or medium-voltage switchgear assemblies. In installations such as this, interactions between the field devices are few in comparison with interactions between the field devices and control station so that, apart from the installation structure, only a small amount of further configuration data is required. A description language for unit communication in accordance with IEC Standard

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61850-6, or its draft, is advantageously used in this variant.

Further preferred embodiments are evident from the dependent patent claims.

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### *Ins. A* **Brief Description of the Drawings**

*Sub A5*

The invention will be explained in more detail in the following text with reference to preferred exemplary embodiments which are illustrated in the attached drawings, in which:

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Figure 1 shows a structure of an installation control system, schematically;

Figure 2 shows a structure of a system according to the invention, schematically; and

15 Figure 3 shows a line diagram of a switchgear assembly.

The reference symbols used in the drawings and their meanings are listed in summarized form in the list of reference symbols. In principle, identical parts are provided with identical reference symbols in the figures.

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*Ins. A6*

Figure 2 shows a structure of a system according to the invention, schematically. One or more field devices 1 are connected to at least one control station 2 via a communications network which is formed from one or more communications buses 3, 5 and bus couplers 4.

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Field devices 1 are control engineering or secondary units. They are used for controlling, regulating and protecting a primary unit 6. Primary units 6 are units which carry out an actual function of an installation, for example circuit breakers, isolators, overhead lines, transformers, generators, motors, turbines, pumps etc.

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At least one device function 11 is stored and can be carried out in a field device 1. The device function 11 comprises an external interface 12 for

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In a first preferred variant of the invention, integration of a field device 1 runs as follows: when the installation of field devices 1 starts, the installation control system has the communications network 3, 4, 5 and the control station 2, with the installation structure 24 not yet being represented in the control station 2. A field device 1 is connected to the communications network. The field device 1 uses a registry service to register its existence in the communications network in a generally known manner, for example by means of a broadcast or multicast method: in this case, the network provides a logic channel on

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which each unit can transmit its presence, its network address and an identity. In a broadcast method, all the units connected to the network receive this information, while in a multicast method, only a subset of units receive this information, that is to say the control station 2 in the present invention. On the basis of the registration of the field device 1, the control station 2 transmits to the field device 1 a request to transmit the functional description 13 of the unit, and the unit then transmits the functional description 13 to the control station 2. This description is preferably laid out in accordance with IEC Standard 61850-6, or its draft. This Standard describes definitions of communications links for station control engineering. It uses an approach and terminology based on a "Client/Server" model, in which servers provide services or functions. Thus, in particular, field devices 1 are regarded as servers which provide their device functions 11 as services. The device functions 11 allow a field device 1 to be controlled by another unit, for example by a higher-level control station 2. To do this, the services or device functions 11 are called by client program elements 23, 23' which are executed, for example, on a control station 2.

The text below, which is explained in what follows, shows the contents of a functional description 13 of device functions 11 of a physical field device which has two logic field devices. The line numbers are not part of the description and have been added for explanatory purposes.

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1    <?xml version="1.0"?>
2    <!-- SCL Version 0.2 -->
3    <!DOCTYPE STATION SYSTEM "scl.dtd">
35  4    <STATION>
5    <BUS name="IBB" type="IEC61850"/>
6    <NODE   name="J01Cnt1"   type="REC316"   bus="IBB"
      addr="47"> <!-- Control -->

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Line 1: a version of XML (Extended Modeling Language)  
which is used.

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Line 4: The start of a description of a station or an installation control system.

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Line 6: The start of a description of a first logic field device in the station, in particular with

[illegible]

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- **DPC** double point control, with attributes for, for example, type (status, measured value, control value, set value), value (activation, deactivation, invalid, undefined), execution time, duration and number of repetitions of control pulses,

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means of the Standard, what data types or structures  
each of these services requires. A call to a service by  
the control unit 2 corresponds to a logic link between  
the control unit 2 and the field device 1. A logic link  
20 is described by the transmitter, receiver and nature of  
a message or of a service. Communication parameters for  
a link are described by the data types and data  
formats.

The engineering application 21 then instantiates one or more associated functions of the control station 23. These functions of the control station 23 are represented, for example, by program elements, by data structures or by objects in the sense of object-oriented programming methodology. The functions of the control station 23 are, for example, "operation of a switch", "reading a state", "plotting a

15 After registration by one or more field devices  
1, the installation representation 22 contains a set of  
primary unit representations and functions of the  
control station 23, which are all associated with in  
each case one specific field device 1 or its device  
20 functions 11. However, the installation representation  
22 has no information about the installation structure.  
This information is now specified by an operator. To do  
this, the input/output unit 25 produces a preferably  
graphic display of the primary unit representations on  
25 the display unit 27. The user uses the input unit 26 in  
a known way to create a graphics representation of the  
installation structure interactively from the primary  
unit representations. The operator in this case  
requires information for this process as to where a  
30 primary unit 6 or an associated field device 1 with a  
specific identification is located in the installation.  
The resulting representation is represented as an  
installation structure 24 on the computer.

One such representation, by way of example, is  
35 a line diagram, as is shown in Figure 3. The line  
diagram shows bus bars 31, isolating switches 32,  
switches 33, a current transformer 34, voltage  
transformer 35, generator 36, three-winding transformer

[illegible]

5               During the production of the installation  
structure 24, the representation has other graphics  
elements which are not shown in Figure 3, for example  
for identification of primary units 6, for symbols and  
identification of field devices 1 and for associations  
10 between primary units 6 and field devices 1.

Other functions of the control station 23 are manually and/or automatically associated with specific data structures or specific graphics elements in the display, by the engineering application 21, on the basis of their nature. For example, functions of the control station 23 which receive events from primary units 6 are combined, so that the events are entered in a common event list. Alternatively, a number of alarm functions are combined, so that a common alarm display is actuated.

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In the variants of the invention described above, class descriptions of functions of the control station 23, which are used as a basis for instantiation, that is to say generic device functions which can be associated with a field device 1, are included in the control station 2 even before the physical installation of a field device 1. In another advantageous variant, such generic device functions are stored in the field device 1 and are transmitted to the control station 2 during the physical installation of the field device 1. This has the advantage that the control station 2 requires even less a priori information about an installation and its equipment before installation and commissioning. In a further advantageous variant, equipment-specific device functions 11 and/or data such as identification are not stored in the field device itself, but the field device is assigned only one address, for example a URL

[illegible]

In a further advantageous variant, a field device 1 contains a number of associated primary units. For example, switches, disconnectors and transformers in a switch panel are controlled by a single physical field device 1. In this case, the field device 1 in each case has at least one dedicated device function 11 for each primary unit.

	1	Field device
	2	Control station
5	3	First communications bus
	4	Bus coupler
	5	Second communications bus
	6	Primary unit
	11	Device function
10	12	External interface
	13	Functional description
	14	Algorithm
	15	Internal interface
	21	Engineering application
15	22	Installation representation
	23,23'	Function of the control station
	24	Installation structure
	25	Representation unit
	26	Input unit
20	27	Display unit